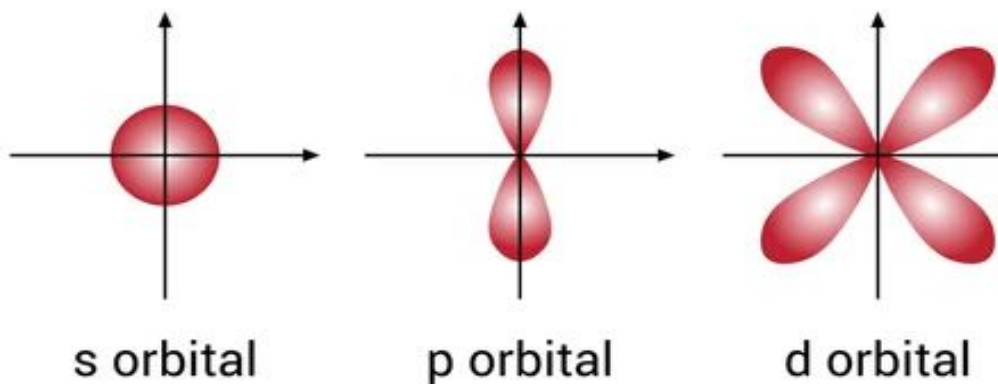
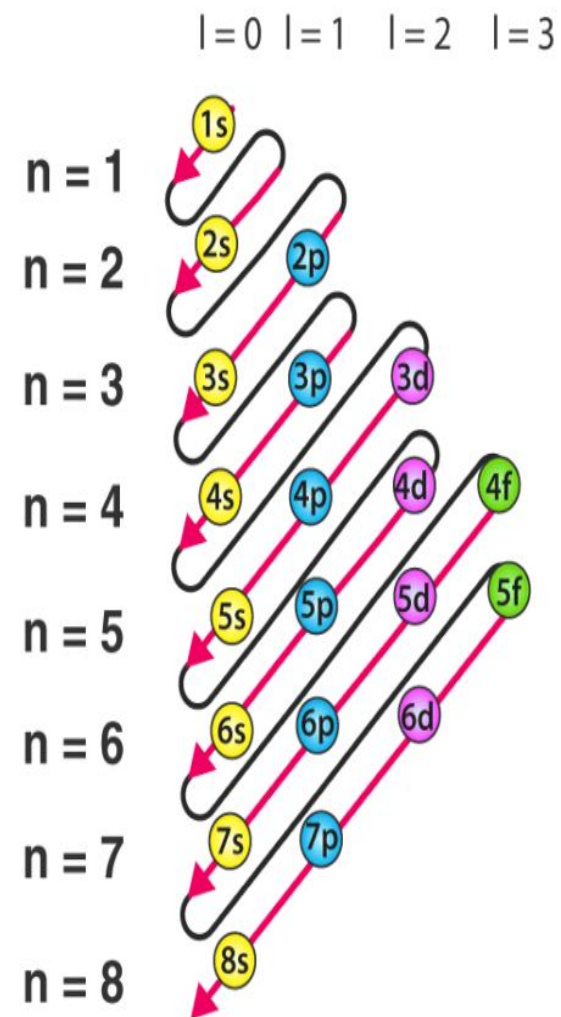


**Electrons levels and sublevels.
Quantum number. Electron
configuration**

Brainstorming



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- Make a list of inferences about any properties of objects in the box.
- How could you learn more about the objects in the box without opening the box?
- Scientist face these same questions as they try to learn more about atoms.

Quantum Numbers

- **Quantum numbers** specify the address of each electron in an atom. There are four types of quantum numbers:
 - 1. Principal quantum number, n → energy level (shell)
 - 2. Secondary quantum number, l → *subshell* (s, p, d, f)
 - 3. Magnetic quantum number, m_l → orbital
 - 4. Spin quantum number, m_s → spin type of
 - There are no two electrons in an atom that can have the same four quantum numbers. Each electron has a unique address, like a family living in a flat. This is **Pauli's Exclusion Principle**.

1. The principal quantum number, n

- determines the size and energy of an atom (larger n means bigger atoms and higher energy),
- can take an integer value $n = 1, 2, 3, 4 \dots$ or (K, L, M, N...),
- all electrons in an atom with the same value are said to belong to the same shell.

2. Secondary quantum number, l

- determines the overall shape of the orbital within a shell
- affects orbital energies (bigger l = higher energy)
- all electrons in an atom with the same value of ' l ' are said to belong to the same subshell
- has integer values between 0 and $n-1$
- may be called the “orbital angular momentum quantum number”

3. Magnetic quantum number, m_l

- determines the orientation of orbitals within a subshell
- does not affect orbital energy
- has integer values between $-l$ and $+l$
- the number of m_l values within a subshell is the number of orbitals within a subshell
- s, p, d and f subshells includes 1, 3, 5 and 7 orbitals respectively.

4. Spin quantum number, m_s

- each orbital may contain two electrons at most
- several experimental observations can be explained by treating the electron as though it were spinning
- spin affects the electron behave like a tiny magnet
- spin can be clockwise (+1/2) or counterclockwise (-1/2)

Solving problems

Example 1

- Find the values of quantum numbers for hydrogen atom.

Example 2

- Show the values of possible quantum numbers for magnesium atom. (^{12}Mg)

Electron configuration

In 1925 **Wolfgang Pauli** stated his exclusion principle;

- ‘In the same atom, two electrons may not have identical sets of all quantum numbers.’
- According to this principle, the quantum numbers, n , l , m_l and m_s , *can never* be identical for two electrons in an atom.

The Aufbau process

- The Aufbau principle basically states that the lowest energy orbitals are filled first.

Hund’s rule states that;

- the electrons are distributed among the orbitals of a subshell of the same energy in a way that gives the maximum number of unpaired electrons with parallel spin.

- $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6, 6s^2, 4f^{14}, 5d^{10}, 6p^6, 7s^2, 5f^{14}, 6d^{10}, 7p^6$

Quest game

Iphone group

- Ca
- Co
-3d⁵ 4s²
- $n=3, l=1$

Samsung group

- Zn
- Br
-3s² 3p⁶
- $n=2, l=0$